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A computed tomographic study of morphometric parameters of the human pineal gland and its age related changes in males.

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Introduction :

The human pineal gland, a part of the diencephalon, is a small neuroendocrine organ that has a function in the circadian rhythm by the secretion of melatonin neurohormone. It is a circumventricular organ because of its deep location in the subarachnoid cistern surrounding the surface of the third ventricle.

Anatomically, the pineal gland is a rounded or crescent-shaped structure like a pine cone and it is attached by the stalk to the diencephalon and the stalk lines the pineal recess whose inferior lip links the pineal gland to the posterior commissure, and superior lip to the habenular commissure.[1]

The pineal gland is also considered to be an active neuroendocrine transducer converting neural input, namely a neurotransmitter released at a synapse, to a hormonal output i.e. methoxyindoles of melatonin and polypeptides. In addition it appears that the pineal may itself be subjected to other hormonal signals suggesting endocrine-endocrine and endocrine neural transduction mechanisms. It was only subsequent to the isolation and characterization of melatonin - a secretion of the pineal gland, by Lerner and his coworkers in 1958 that a lot of the functional significance of this enigmatic gland has begun to be unraveled.[2,3]

The cyclic nature of the gland's activity earned it the title of a 'biological clock', a switching mechanism regulating the activity of the sex glands in response to the changing seasons and exposure to light and dark. The pineal gland in all mammals produces melatonin in a rhythmic manner with peak levels occurring at night irrespective of whether the animal is nocturnal or diurnal in its behavior pattern. The major functions of pineal melatonin appear to synchronize the seasonal and circadian rhythms of a variety of physiological events.

These include effects on reproduction, coat growth, temperature regulation and locomotor activity in species where seasonal cycles depend on photoperiod.[4,5,6]

The pineal gland has inspired novel avenues of research due to its unique nature and its discrete association with the sympathetic nervous system. The pineal has a modulator effect,

changing the timing, amplitude or intensity of the response rather than a primary effect of initiating such responses. [7,8,9]

It is no longer a of what organs or organ systems the pineal and melatonin influences but rather it is a question of whether any escape its influence. Govitrapong et al., have identified and characterized the presence of muscarinic cholinergic receptors in the pineal glands of cow and swamp buffalo by using quinuclidinyl benzilate binding studies. [10,11]

The pineal gland is innervated almost exclusively by sympathetic nerves from the superior cervical ganglia and although recently muscarinic receptors have been found in the pineal glands, their function still remains a mystery. This study served to explore the use of the rat pineal gland as a model for the investigation into cholinergic interactions in the pineal gland as well as to determine the role that these muscarinic cholinergic receptors play in this gland. A number of cholinergic agents was used and their effect on pineal function and metabolic pathways examined.[12,13]

The present study was conceived, to see the any kind of variation in the different parameters of pineal gland with regard to the age of the individual, because its size and volume is related with its physiological functions. While considering all these factors, study of morphometric parameters of pineal gland and variations in its parameters with age assume great importance to the medical fraternity to differentiate between normal and pathological pineal gland

Aims and objectives

To study the morphometric parameters of pineal gland by CT Scan and their variations in the parameters and volume with different age groups in 100 patients who visited in the out-patient and/or admitted in the wards of Index Medical College Hospital and Research Centre Indore, MP and undergone for CT Scan head and having no pathology in the pineal gland.

This study will be very informative to know the morphometric variations in pineal gland with different age groups.

1. The objective of the study is to compare the length, width, thickness and volume of the pineal gland in different age groups.in males
2. To establish facts about the age related changes in the Morphometry of the pineal gland in females.

MATERIAL & METHODS

Patient Population

The study group consisted of 200 patients (age range: 21-79 years, average 39.69 SD 13.84 years) Who had undergone cranial CT scan studies at Index Medical College Hospital and Research Centre Indore, MP, Department of Radiology over a period of One and half years. The radiology reports and electronic medical records of each patient were reviewed to determine the indication for and to record any history of surgery to the epiphyseal area, or symptoms referable to the pineal gland. For the purposes of this study, patients were excluded if there was a history of pineal tumor, cyst, or dysfunction, if there was any brain abnormality adjacent to the pineal gland, patients with any known endocrinologic disorder or malignant tumor as well as those who were undergoing radiation therapy or chemotherapy or if the required images were missing or destroyed. The study has undertaken only after ethical review and approval from ethical committee. The relevant information was collected from the

patient's case file and by any means patient has not been interviewed. The name of the patient has not included in the recording format to maintain the patient confidentiality so the patient consent was not necessary. Image Acquisition All images were obtained with a 3D CT Scan Machine 128 slice of Wipro G Company. Size=1mm x 1mm × 1 mm; slice thickness -1mm without gap.

In this study, the pineal boundary was exactly identified on the sagittal sections taken in addition to coronal and axial views. Antero-posterior dimension was measured in the sagittal view and vertical and transverse dimensions were measured in coronal and axial views. Material & Methods Page 23 Volume Estimation It is done by using planimetry, which involves manually tracing the boundaries of objects of interest on images of sections is the most commonly used technique for estimation of volume. The volume (V) was calculated according to the formula: V= 1/2 x H x L x W Statistical Analysis Statistical analysis was performed using SPSS 16.0 (SPSS Inc. Chicago, IL). We use statistical tools like mean, SD, test, diagrams, one way analysis of variance for comparing different parameters of pineal gland with respect to sex and age groups.

Observation & Result

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Table No. 1 : Frequency distribution of male & female according to age groups.

Sex	**Age Group**				**Total**
	<30	**31–40**	**41-50**	**>50**	
Female	18	12	16	8	54
Male	38	40	36	32	146
Total	**56**	**52**	**52**	**40**	**200**

Table No. 02: Mean and significant values of pineal gland length, width, thickness and volume in age groups (<20 & 31-40) in males.

Variables	**Age**	**N**	**Mean**	**Std. Deviation**	**P Value**
Length	<30	38	7.0516	.13570	0.396
	31-40	40	7.1095	.26265	
Width	<30	38	6.7074	.25203	0.970
	31-40	40	6.7125	.52690	
Thickness	<30	38	4.1037	.20318	0.193
	31-40	40	194.07	11.98839	
Volume	<30	38	194.07	11.98839	0.136
	31-40	40	202.24	20.24290	

Table No. 03: Mean and significant values of pineal gland length, width, thickness and volume in age groups (<30 & 41-50) in males.

Varables	Age	N	Mean	Std. Deviation	P Value
Length	<30	38	7.0516	0.13570	0.206
	41-50	36	7.1394	0.26278	
Width	<30	38	6.7074	0.25203	0.835
	41-50	36	6.7250	0.25862	
Thickness	<30	38	4.1037	0.20318	0.026*
	41-50	36	3.9317	0224462	
Volume	<30	38	194.07	11.98839	0.259
	41-50	36	188.81	15.75813	

Table No. 04: Mean and significant values of pineal gland length, width, thickness and volume in age groups (<30 & >50) in males.

Varables	Age	N	Mean	Std. Deviation	P Value
Length	<30	38	7.0516	0.13570	0.056
	>50	32	7.2231	0.34752	
Width	<30	38	6.7074	0.25203	0.002*
	>50	32	6.9606	0.18332	
Thickness	<30	38	4.1037	0.20318	0.113
	>50	32	3.9813	0.24202	
Volume	<30	38	194.07	11.98839	0.218
	>50	32	200.26	17.06996	

Table No. 05: Mean and significant values of pineal gland length, width, thickness and volume in age groups (31-40 & 41-50) in males.

Varables	Age	N	Mean	Std. Deviation	P Value
Length	31-40	40	7.1095	0.26265	0.728
	41-50	36	7.1394	0.26278	

Width	31-40	40	6.7125	0.52690	0.928
	41-50	36	6.7250	0.25862	
Thickness	31-40	40	4.2580	0.46686	0.012*
	41-50	36	3.9317	0.24462	
Volume	31-40	40	202.24	20.24290	0.030*
	41-50	36	188.81	15.75813	

Table No. 06: Mean and significant values of pineal gland length, width, thickness and volume in age groups (31-40 & >50) in males.

Varables	**Age**	**N**	**Mean**	**Std. Deviation**	**P Value**
Length	31-40	40	7.1095	0.26265	0.271
	>50	32	7.2231	0.34752	
Width	31-40	40	6.7125	0.52690	0.082
	>50	32	6.9606	0.18332	
Thickness	31-40	40	4.2580	0.46686	0.039*
	>50	32	3.9813	0.24202	
Volume	31-40	40	202.24	20.24290	0.757
	>50	32	200.26	17.06996	

Table No. 07: Mean and significant values of pineal gland length, width, thickness and volume in age groups (41-50 & >50) in males.

Varables	**Age**	**N**	**Mean**	**Std. Deviation**	**P Value**
Length	41-50	36	7.1394	0.26278	0.431
	>50	32	7.2231	0.34752	
Width	41-50	36	6.7250	0.25862	0.005*
	>50	32	6.9606	0.18332	
Thickness	41-50	36	3.9317	0.24462	0.557
	>50	32	3.9813	0.24202	

Volume	41-50	36	188.81	15.75813	0.050*
	>50	32	200.26	17.06996	

Table No 08 : One way ANOVA for different parameters of male with respect to age groups.

Variable	Source	Sum of Squares	Df	Mean Square	F	Sig.
Length	Between Groups	0.265	3	0.088	1.316	0.276
	Within Groups	4.628	69	0.067		
	Total	**4.892**	**72**			
Width	Between Groups	0.758	3	0.253	2.164	0.100
	Within Groups	8.059	69	0.117		
	Total	**8.818**	**72**			
Thickness	Between Groups	1.196	3	0.399	4.056	0.010*
	Within Groups	6.780	69	0.098		
	Total	**7.976**	**72**			
Volume	Between Groups	2061.033	3	687.011	2.500	0.067
	Within Groups	18964.880	69	274.853		
	Total	**21025.913**	**72**			

Conclusiuon –

In the present study, we evaluate the morphometric parameters of pineal gland by 3 DCT scan in a tertiary care institute in Ujjain.

The conclusions of present study are-

1. Pineal gland mean length gradually increased with age.
2. The width of the gland is increased up to the 40 years then it slightly decreased with age.
3. There is no particular pattern of the thickness, as it first increased with age and then decreased.
4. The volume of gland slightly increased up to the age of 40 years with age and then there is fall in 41-50 years age groups, then again increase in volume was noted.
5. There was significant difference in length ($p<0.01$), thickness and volume ($p<0.05$) between different age groups but no significant difference was found in width.
6. In males significant difference was found in the width and volume between 41-50 and >50 age groups ($p<0.05$).

In the pineal region, where a variety of tumors occur, including germ cell tumors and pinealoma, knowledge of the normal size of the developing gland can help to distinguish healthy tissue from tumor. In addition, the lack of a blood-brain barrier in the normal pineal gland results in an inability to separate a normal gland from a neoplasm on the basis of enhancement characteristics.

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